man. The real issue is what technology would Verizon employ *today* if it were not constrained by its existing network design.

In sum, Verizon's models are not TELRIC models. They do not model the most efficient technology currently available, and so do not allow the Commission to value Verizon's network based on TELRIC principles.

Verizon's models and inputs are so at war with TELRIC fundamentals that Verizon itself, speaking through its General Counsel at the United States Supreme Court, and through the same economic experts upon which it relies here, has described the fundamentals of TELRIC in ways that make plain that its models violate FCC rules. Indeed, the models are so obviously not TELRIC models that two of its principal economic witnesses here, Drs. Shelanski and Hausman, would not defend the models as TELRIC when directly asked to do so at the hearings.

Thus, in its recent brief to the United States Supreme Court on review of the merits of the *Local Competition Order*,[12] Verizon described in vivid (if pejorative) fashion the critical components of TELRIC, and did so in a way that starkly highlights the extent to which its current models depart from TELRIC.

Here Verizon asserts that the "starting point of the investment analysis is an existing network rather than a blank slate." Verizon Exh. 117 (Shelanski/Tardiff Surreb.) at 5. But at the Supreme Court, Verizon acknowledged that "the FCC explicitly rejected any measure tied to the incumbent's actual network and present or future cost structure," *IUB Br.* at 3, and that "TELRIC necessarily ignores the reality that the incumbent has an existing network whose

[12] WorldCom Exh. 101, Brief of Respondents BellSouth, SBC, Verizon and USTA, in *WorldCom, Inc. v. Verizon Communications, Inc.*, Nos. 00-555 et al., (U.S. filed June 8, 2001).

future capital costs and operating expenses are in large part dictated by the network's current configuration." *Id.* at 11.

Here Verizon defends a model that operates by "estimat[ing] Verizon's costs of efficiently replacing and expanding its facilities over time," Verizon Ex. 110 (Shelanski Reb.) at 4, and asserts that proper costing "does not imply an instantaneous and complete replacement of the existing network." *See also id.* at 6 ("A more reasonable application of a model such as TELRIC is to assume that the network is replaced incrementally over a reasonable planning period."). *Id.* at 5. But at the Supreme Court, Verizon acknowledged that "the FCC's methodology asked what particular elements would cost if the entire telephone network were rebuilt from scratch, as though writing on a blank slate." *IUB Br.* at 5.

Even in this very proceeding, Verizon's witnesses have characterized TELRIC in a manner that makes clear Verizon's models are not TELRIC models, and have identified as the key precepts of TELRIC the precise modeling assumptions Verizon's current models *reject.* Most remarkably, though the question of whether the competing models are faithful to TELRIC is the central "economic" question before the Commission in the context of this proceeding, two of Verizon's "economic" witnesses studiously avoided making any assertion that the models are TELRIC. Instead, the brunt of their testimony was that they disagreed with TELRIC and concluded it was a poor model that the Commission should abandon.

Dr. Hausman was direct about his contempt for TELRIC. He readily acknowledged that the arguments he advanced in support of Verizon's model were the very same arguments he made opposing the FCC's TELRIC proposals in 1996. Tr. 3237-3238 (Hausman). He stated that consideration of Verizon's model gave "the Commission a second chance" to correct the errors it made in 1996 when it adopted TELRIC. *Id.* at 3237. He was apparently unaware that the FCC has no authority to do so in this proceeding. To paraphrase his own

criticism of the former chairman of the FCC, *id. at* 3238, whatever his skills as an economist, Dr. Hausman obviously is no lawyer, and his testimony completely undermines Verizon's claims that its criticisms of the Synthesis Model are consistent with TELRIC.

Dr. Shelanski was more circumspect, but his silence was every bit as damning to Verizon as Dr. Hausman's *ad hominem*. When asked point blank whether "in your view both the Verizon model and the WorldCom model satisfy the Commission's TELRIC rules," his response was "I can't really comment on what objectively as a legal matter the Commission's TELRIC rules are." Tr. 2833-2834 (Shelanski). Coming from a lawyer who formerly addressed issues of TELRIC's legality on a daily basis for Verizon and the other ILECs, Dr. Shelanski's refusal to answer that question spoke volumes. Indeed, Dr. Shelanski went further, stating that although he would defend Verizon's model in economic terms, "I wouldn't be comfortable saying that the model complies with as a legal matter, what the Commission has decided its rule is." Tr. 2834 (Shelanski). *See also id.* at 2841 ("I'm not here testifying that Verizon's model is faithful to . . . Verizon's description of what the FCC has done"); *id.* 2907 (Q: "In your view TELRIC permits [Verizon] to consider what it currently has in the ground as it builds its forward-looking network?" A: "In my view, *an economically correct forward-looking cost model* would have to take into account what [Verizon] has in the ground." (emphasis added)). In the end, Dr. Shelanski did voice one legal opinion: he acknowledged that, if Verizon's own understanding of TELRIC was correct, then "what I advocate as the economically correct interpretation would not be legally permissible." Tr. 2849 (Shelanski).

Indeed, not only was Dr. Shelanski unwilling to defend the proposition that Verizon's model is compliant with TELRIC, ultimately he also was unwilling to defend the model as rational at all. Instead, it is apparently his view that Verizon attempted to construct a model that aspired in some ways to conform to TELRIC rules, in other ways aspired to model

costs in a rational manner, but in the end failed to accomplish either. As he said, "a lot of what [Verizon] did [in its cost model], and as I made clear in my direct testimony, what I think would be theoretically correct is quite different from the model that Verizon has put in place. Their model was put in place as an effort to be correct, given the constraints of TELRIC." Tr. 2949 (Shelanski). Similarly, when Staff asked him to acknowledge that TELRIC could in theory properly measure the value of Verizon's existing network, he responded that TELRIC was indeed one of several ways that could be accomplished, but that there were other more reliable methods the Commission should have adopted. Tr. 3091-3092 (Shelanski). When Staff followed up by asking "to your knowledge, does the Verizon model use any of the methods you just described?" he pointedly declined to answer the question. Tr. 3094 (Shelanski).

Dr. Tardiff was the only witness willing to assert that Verizon's model conformed to TELRIC, but only by contorting the *Local Competition Order's* "serving wire center" exception such that, from his unique perspective, it would extend to cover every piece of the existing telephone network. Tr. 2855 (Tardiff). Even leaving this aside, his credibility would have been better served by following Dr. Shelanski's example, for outside the hearing room he too has been perfectly clear that TELRIC cannot be contorted to support a cost model like Verizon's. Thus, he has written that the FCC "has explicitly rejected proposals by the ILECs that the rates be 'based on' their own projected actual incremental costs as variants of the 'embedded cost' approach traditionally employed by regulatory commissions in setting rates. It

forthrightly adopts the hypothetical TSLRIC-BS concept."[13] In this criticism he is joined by Alfred Kahn, a vocal critic of TELRIC on behalf of the incumbent LECs, who is equally clear that the FCC "prescribed the blank-slate version of TELRIC as the basis for pricing UNEs,"[14] and that "the FCC has explicitly rejected proposals by the ILECs that the rates be based on their own projected actual incremental costs . . . and forthrightly adopts the hypothetical TSLRIC-BS concept."[15]

In sum, based even on Verizon's own understanding of TELRIC, it is clear beyond any dispute that Verizon's models are not TELRIC models, and not even Verizon's own witnesses attempted to make a plausible case that they are.

4. Verizon's Criticisms of TELRIC Lack Merit.

Because Verizon's models and inputs so clearly violate TELRIC, the Commission need not consider further those models or the Verizon witnesses' criticism of TELRIC and the AT&T/WorldCom TELRIC models. The Commission in this proceeding is acting in the place of the Virginia Commission, and state commissions are required to follow the FCC's rules in arbitrating disputes over proposed interconnection agreements. 47 C.F.R. § 51.505(e)(1). *See also* 47 U.S.C. § 252(e)(5). The Commission is not free to change those rules here. TELRIC

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[13] Kahn, A., Tardiff, T., Weisman, D., The Telecommunications Act at Three Years: An Economic Evaluation of Its Implementation By the Federal Communications Commission, in *Information Economics and Policy* 11 (1999) 311, 326 n. 14. *See also id.* at 328 ("The Commission has in effect declared: 'We will determine not what your costs are or will be but what we think they ought to be."); *id.* (criticizing the FCC for failing to understand that proper understanding of economics "require[s] that the prices charged to competitors be based upon the LECs' actual costs").

[14] Kahn, A., *Whom the Gods Would Destory, or How Not to Deregulate* (2001), at 3.

[15] Kahn, A., *Letting Go: Deregulating the Process of Deregulating the Process of Deregulation, or: Temptation of the Kleptocrats and the Political Economy of Regulatory Disingenuousness* (Inst. of Pub. Utils & Network Indus. (1998), at 91 n. 129.

rules were adopted in a rulemaking after notice and comment, and cannot be revised or abandoned "until such time as [the FCC] alter[s] them through another rulemaking." *Southwestern Bell Tel. Co. v.* FCC, 28 F.3d 165, 169 (D.C. Cir. 1994).

But lest the Commission think that there is merit to any of Verizon's criticisms of TELRIC, in what follows we demonstrate that Verizon's criticisms of the FCC's rules lack substance.

Part of Verizon's criticism of TELRIC relies on the "real options" theory propounded by Professor Hausman. He argues that the Synthesis Model understates costs because it does not take into account sunk costs or technological change, and he claims that Professor William Baumol and Dr. Richard Clarke have agreed that the sunk costs lead to a free option for CLECs that results in underinvestment by both the CLEC and the incumbent carrier. Verizon Exh. 111 (Hausman Reb.) at 6-18. As a result, Dr. Hausman claims that the Synthesis Model TELRIC prices should be increased by 97% to 120% to take account of this understatement. *Id.* at 18-19.

As Dr. Hausman conceded during cross-examination, his arguments are little more than a rehash of claims that were considered and rejected by the FCC in its *Local Competition Order*. 11 Tr. 3236-48 (Hausman); *Local Competition Order* ¶¶ 686-89; WCOM Exh. 103 (Hausman testimony to FCC in 1996). Professor Hausman's attempt to enlist Professor Baumol and Dr. Clarke as supporters of his claims is a gross mischaracterization of their views and of real options theory. *See* AT&T/WCOM Exh. 20 (Murray Surreb.) at 4-33. In fact, in the very publication that Dr. Hausman misleadingly cites in his testimony, Dr. Baumol notes that Dr. Hausman's claim that real options theory requires an a big markup over TELRIC-based prices to reflect options values betrays a "superficial consideration of the matter." A more careful and systematic application of real options theory, Dr. Baumol adds, could lead to the *opposite*

result—that is, to a recommendation that UNE prices be set *lower* than would otherwise be required under a strict application of TELRIC pricing principles.[16] *Id.* at 6-7 & Att. A.

At the heart of Verizon's assault on TELRIC (and of Dr. Hausman's misapplication of the real options theory) is its view that the Commission erred in calling for a long-run study assuming the deployment of the most efficient technology. In Verizon's view, such studies avoid any consideration of existing facilities, and those facilities represent sunk costs that powerfully constrain Verizon's choices, and the choices of any "real world" carrier that provides network services to a large group of customers. If Verizon were trying to model equipment it would deploy in its network over the reasonably foreseeable future, it would be foolish to make the long-run assumption that TELRIC requires, because in the real world Verizon can neither wish away its existing network, nor make any useful assumptions about what the world will look like when all of its existing equipment has been retired. Moreover, any carrier serving demand the size of Virginia would operate with a mix of old and new equipment, and could never at any given instance replace all of its equipment at once with the most up-to-date and efficient equipment available.

Consequently, in Verizon's view, the optimally efficient network that TELRIC hypothesizes "is the result of the unrealistic assumption that there will always be a carrier capable of ubiquitous deployment of new technology and network design," and presents a "distorted view of competitive prices." Verizon Ex. 117 (Shelanski/Tardiff Surreb.) at 10.

It is on that basis, for example, that Verizon's witnesses repeatedly assert that for TELRIC to produce realistic prices, it must be populated with unrealistic inputs. Thus they

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[16] William J. Baumol and Richard N. Clarke, "Option Value Analysis and Telephone Access Charges," in J. Alleman and E. Noam, eds., *The New Investment Theory of Real Options and its Implications for Telecommunications Economics*, 1999, at 218 (hereafter, Baumol, 1999), included as Attachment A to AT&T/WCOM Ex. 20 (Murray Surreb.).

assert, for example, that the only way TELRIC could accurately model costs would be if the depreciation rate for the entire network is "whatever the period between TELRIC pricing proceedings is." Tr. 3162 (Shelanski). *See also* Tr. 3172 ("it's absolutely the case that your full economic life is the time until the next proceeding when you are fully replacing" the network) (Shelanski). After all, Verizon insists, only if that were the case would a carrier ever operate with entirely new equipment configured in the most up-to-date way.

But as an exasperated Staff member pointed out in questioning the Verizon witnesses, these criticisms, despite their long pedigree, are based on a simple misunderstanding of TELRIC, or alternately on a studied refusal to engage in a meaningful criticism of the FCC's methodology. As Staff noted, TELRIC is not based on the insane assumption "that you have to pull out" the network every three years, but is a "hypothetical" construct designed to value the existing network in a way that simulates how changes in technology and market conditions cause the revaluation of existing assets in competitive markets. Tr. 3172. "I think we are confusing here actual investments that real companies do and the way costs are modeled in a TELRIC proceeding." Tr. 3111. *See also* Tr. 3124.

As staff noted, the obvious purpose of a long-run study is to construct a *hypothetical* carrier using the most up-to-date technology serving total demand, because modeling the cost of that up-to-date technology is one way to measure the true value of the technology that a real world efficient carrier uses to serve the same demand, *whether or not it or any other carrier deploys the most recent technology.* The economic assumption upon which the model is based, in other words, is *not* that there will be some carrier in the real world that every three years actually deploys a network identical to the one that TELRIC hypothesizes. It is instead that the true economic value of an ILEC's equipment is not what it paid for it, but what it is worth in light of new technology available today that necessarily has the effect of lowering the

value of the ILEC's embedded technology. In other words, the prices TELRIC models produce are not the hypothetical carrier's, but Verizon's.

Its rhetoric notwithstanding, Verizon does not actually dispute this assumption. To the contrary, its witness Dr. Shelanski stated the assumption succinctly in his testimony when it served Verizon's purposes to acknowledge it, noting that "the mere existence of new technology lowers recurring costs whether or not it is efficient for the carrier actually to deploy new technology, because the innovation may reduce the depreciation costs of existing facilities." Verizon Exh. 110 (Shelanski Reb.) at 21. As Dr. Shelanski acknowledged in cross-examination, whether or not a new switch is deployed, the efficiencies of that new switch "put[] a constraint on how high a value you can attribute to your existing switch." Tr. 2922 (Shelanski). Indeed, because appropriate economic depreciation of efficiently deployed assets also takes into account technological changes in equipment, Verizon is forced to acknowledge in the end that the much discussed theoretical "gap" between the cost of "real" networks and TELRIC costs is made up of nothing more than hot air. A hypothetical "new entrant with the optimal network doesn't necessarily have long-run costs lower than those of an incumbent that efficiently and incrementally expands and replaces its network." Verizon Exh. 117 (Shelanski/Tardiff Surreb.) at 16.

Only once in hundreds of pages of testimony did Verizon's witnesses ever acknowledge what seems to be its real view: that valuing assets is "a hard problem," that TELRIC is one of several perfectly coherent methods to value assets, but that all methods create practical difficulties, and that in Dr. Shelanski's view at least, "the alternative of using the wholly reconstructed network" as a model to measure value "raises in fact greater problems than trying to measure the value of the existing network." Tr. 3091.

That criticism of TELRIC, on which Dr. Shelanski did not further elaborate, is, of course, far removed from the rhetoric of "BS TELRIC" and absurd assumptions about tearing up up the network every three years that permeates Verizon's economic case. Had Verizon started rather than ended its testimony by making this point, possibly the hearing would have led to a fruitful discussion of the merits of the reasons the Commission gave for using TELRIC to price assets. In the FCC's view, TELRIC was the preferable method because it best mimicked the performance of effectively competitive markets; because the TELRIC standard minimized reliance on information that was solely within the ILEC's control; because the FCC expressed doubts about claims that the ILEC's embedded costs were efficiently incurred; because of the difficulties inherent in allocating costs of equipment needed to provide telecommunications services based on ILEC books and records that do not allocate costs in this manner; and because of concerns that the risks of overstating costs as a result of reliance on ILEC books and records could lead to serious competitive harms. Whatever are Verizon's real concerns about these assumptions, and about TELRIC in general, it evidently did not feel they were persuasive enough to air them here.

B. Model Design

1. The Synthesis Model.

As submitted, the Synthesis Model proposed by AT&T and WorldCom is the best model for determining the TELRIC of UNEs in Virginia. The Synthesis Model, developed over several years by the Commission in the Universal Service Fund proceeding, uses forward looking economic cost principles to calculate the economic costs that an efficient company would incur to provide basic telephone exchange service. It represents the concerted effort by this Commission, as an independent third party, to take the best aspects of various existing cost methodologies in developing a model for deriving costs for providing telephone service. The

entire telecommunications industry (including Verizon and its predecessor entities Bell Atlantic, NYNEX, and GTE) participated in the several years of USF proceedings leading to the adoption of the Synthesis Model, and as a result, the Synthesis Model has been the subject of rigorous analysis and examination regarding its underlying assumptions, algorithms, and inputs. The Synthesis Model incorporates consistent long-run incremental cost principles that apply both to the development of universal service and the determination of costs for unbundled network elements, thus eliminating the possibility of arbitrage. As such, the Model gives correct economic signals regarding entry and investment, and incumbent carriers are not rewarded for existing inefficiencies. Moreover, the Synthesis Model is flexible and allows the use of state-specific inputs. Finally, the Synthesis Model allows the development of costs for individual UNEs with only minor changes that can be reviewed and tested using the Model's adjustable algorithms and inputs. AT&T/WCOM Exh. 14P (Pitkin Surreb.) at 4-5.

This section discusses the development of the FCC Synthesis Model, the principal features of the Synthesis Model as presented in this proceeding by AT&T and WorldCom, and the changes made to the FCC Synthesis Model to permit the development of UNE costs. It then sets forth the reasons why Verizon's criticisms of the Synthesis Model are without merit. The principal features of Verizon's models are then described, followed by a discussion of the shortcomings of Verizon's cost studies

a. The Development of the FCC Synthesis Model.

The FCC Synthesis Model was originally developed by the Commission in the Universal Service Proceeding for use in establishing universal service support levels for rural and high-cost areas. Section 254 of the Telecommunications Act of 1996 directed the FCC to abandon the prior scheme of subsidies that supported service to high-cost areas and to devise instead a universal service support mechanism that was compatible with the pro-competitive

provisions of the 1996 Act. In response, the FCC began an administrative proceeding that, in conjunction with the Federal-State Joint Board on Universal Service, adopted the use of a long-run, forward-looking economic cost methodology and committed to develop a cost model to calculate support for high-cost areas. *Universal Service First Order*. The FCC specifically considered, and rejected, the use of ILEC embedded costs because these costs sent the wrong economic signals and promoted inefficiency. The forward-looking economic cost model was preferable, the FCC found, because the use of these costs, even though not actually incurred, sent the appropriate economic signals, encouraged efficient investment, and would calculate the required level of supported services:

> We concur with the Joint Board's finding that the use of forward-looking economic costs as the basis for determining support will send the correct signals for entry, investment, and innovation.
>
> . . .
>
> The technology assumed in the cost study or model must be the least-cost, most-efficient, and reasonable technology for providing the supported services that is currently being deployed. Only long-run forward-looking economic cost may be included. The long-run period used must be a period long enough that all costs may be treated as variable functions, or elements.

Universal Service First Order at ¶¶ 224, 250.[17]

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[17] The Commission reaffirmed this point in its *Universal Service Fifth Order*:

> As the Joint Board recognized, providing support based on embedded cost provides the wrong signals to potential market entrants. If embedded costs exceed forward- looking costs, such support would encourage inefficient entry. In contrast, providing support based on embedded costs that are below forward-looking economic costs would dissuade market entry even where such competition would be economically efficient. The Commission concurred with the Joint Board's finding that the use of forward-looking economic costs as the basis for determining support will

In 1998, after multiple requests for information and consideration of voluminous filings by parties, the Commission issued its Platform Order in the USF proceeding in which it adopted the forward-looking Synthesis Model to determine the cost of operating the network facilities that provided the services that were eligible for universal service support. Consistent with the finding about forward-looking costs, the FCC Synthesis Model was designed to reflect the operation and costs of an efficient carrier providing the supported services and allowed flexibility in adjusting various assumptions about the network. *Universal Service Fifth Order* at ¶ 4.

Having established the model for use in USF calculations, the Commission again requested comments from parties on the appropriate input values for the model. In its *Universal Service Tenth Order*, the Commission reaffirmed its adoption of the Synthesis Model, citing six months of staff validation tests, and concluded that the Synthesis Model provided an appropriate basis for determining federal universal support in a competitive environment. *Id.* at ¶ 23. Having made this determination, the Commission then considered the various input proposals submitted by parties and selected the input values for use in the various modules of the Synthesis Model for calculating federal universal support for high-cost areas. The Commission used nationwide inputs for its universal support calculations largely because these more accurately represented forward-looking costs. It specifically recognized that the Synthesis Model had the flexibility to allow state commissions to substitute state and company-specific inputs in making determinations about state universal service fund levels or costs for UNEs:

> send the correct signals for entry, investment, and innovation. The Commission found that a forward-looking economic cost methodology creates the incentive for carriers to operate efficiently and tends not to give carriers an incentive to inflate their costs or to refrain from efficient cost-cutting.

Universal Service Fifth Order at ¶ 10.

> State Commissions . . . may find it is not appropriate to use nationwide values in determining state universal service support or prices for unbundled network elements and may choose instead to use statewide or company-specific values.

Id. at ¶ 31 n. 66.

b. The Synthesis Model Submitted in This Proceeding

In this proceeding, AT&T/WorldCom base their UNE cost estimates on the Synthesis Model submitted by AT&T/WorldCom witness Brian Pitkin. AT&T/WCOM Exh. 1 (Pitkin Dir.) at 5-9; AT&T/WCOM Exh. 14 (Pitkin Surreb.); AT&T/WCOM Exh. 23.(Cost Studies and Supporting Documentation Setting Forth Cost Model Outputs for Unbundled Network Elements and Associated Non-Recurring Charges Submitted by AT&T Communications of Virginia, Inc. and WorldCom, Inc. ("AT&T/WCOM Cost Models")). The AT&T/WorldCom filing of the Synthesis Model in this proceeding recognizes that the Model was originally developed to determine costs in USF proceedings, and as discussed in more detail below, makes appropriate adjustments. AT&T/WCOM Exh. 8 (Murray Dir.) at 11-13.

The Commission developed the Synthesis Model by combining what it regarded as the best elements of three state-of-the-art cost models sponsored by AT&T, WorldCom and the incumbent LECs: "(1) the BCPM, Version 3.0 (BCPM), (2) the HAI Model, Version 5.0a (HAI), and (3) the Hybrid Cost Proxy Model, Version 2.5 (HCPM)."[18] These three UNE cost models were melded together to produce a model that takes into account thousands of inputs and variables and produces costs of providing a range of telecommunications services. The Synthesis Model in particular consists of five different sets of algorithms: (1) clustering,

[18] *Universal Service Tenth Order* at ¶ 8 (footnotes omitted); AT&T/WCOM Ex. 23 (AT&T/WCOM Cost Models) at Exh. B.

(2) distribution, (3) feeder, (4) switching and interoffice, and (5) expense calculations. Each algorithm plays a distinct role in constructing and estimating costs of local telephony networks.

The first three algorithms (clustering, distribution and feeder) deal with outside plant (also referred to as the loop), the largest cost component of the local telephone network, comprising approximately two thirds of the total costs of the network. Exhibit B to AT&T/WCOM Exh. 23 (AT&T/WCOM Cost Models), "Computer Modeling of the Local Telephone Network," describes the clustering, distribution and feeder algorithms of the Synthesis Model in greater detail.

The clustering process starts with surrogate customer locations. The loop module of the Synthesis Model relies on each customer's geographic location (*i.e.*, longitude and latitude) to group them into serving areas. Once that has been accomplished, the Synthesis Model assigns customers to a distribution grid, which is generally 360 by 360 feet in size, that is then used for the purpose of building distribution plant. These locations are then grouped into clusters, by wire center, subject to user-defined engineering constraints. This process also generates serving area interface, or "SAI" locations (also called a feeder/distribution interface, or "FDI"), the number of customer locations, and lines per customer in each cluster for processing in later algorithms. AT&T/WCOM Exh. 1 (Pitkin Dir.) at 7; Exh. B.

The distribution algorithms follow the clustering algorithms. The Synthesis Model places a grid over a cluster, and then divides the grid into a matrix of microgrids. These microgrids are next segmented into customer lots, based on the number of lines within the microgrid. Drop terminals are then placed in the microgrid to serve each customer lot. Finally, the distribution algorithms connect the universe of drop terminal locations to their serving SAIs/FDIs. *Id.*

After completing construction of the distribution plant in a wire center, the Synthesis Model designs the feeder plant. This process connects each cluster's serving SAI/FDI with the central office. When the clustering, distribution and feeder algorithms are complete, the Synthesis Model estimates the investment required for the local telephone exchange network's local loop. *Id.*

The Model also develops the appropriate switching and interoffice costs and makes appropriate expense allowances.

c. Modifications to Synthesis Model.

Mr. Pitkin modified several of the default algorithms and inputs of the Synthesis Model approved by the FCC. These modifications: (1) correct implementation errors; (2) update the model inputs to reflect current data; (3) change the common support calculations to develop UNE costs; (4) modify the model inputs to incorporate various input changes; and (5) incorporate changes made to the interoffice module.[19]

(1) Correction of Implementation Errors

The implementation errors corrected by Mr. Pitkin include the erroneous placement of drop terminals outside of the microgrid to which they are assigned; the placement of drop terminals away from their serving SAI/FDI; the design of customer lots that exceed a stated lot constraint established by the Commission Staff providing that lot depth should be between one and two times the lot width; the selection of certain incorrect inputs; and the incorrect rounding of the lines per location instead of rounding the lines per microgrid, which causes the model to move lines from their original location. AT&T/WCOM Exh. 1 (Pitkin Dir.) at 9; AT&T/WCOM Exh. 23 (AT&T/WCOM Cost Models) at 4-5 & Att. C. Mr. Pitkin also

[19] AT&T/WCOM Exh. 1 (Pitkin Dir.) at 9-19; AT&T/WCOM Exh. 23 (AT&T/WCOM Cost Models) at 3-10; AT&T/WCOM Exh.14 (Pitkin Surreb.) at 71-74; AT&T/WCOM Exh.6 (Riolo Dir.).

made several corrections to the optimization algorithms of the model to satisfy the Commission's forward-looking requirement. *Id.*

(2) Use of Current Data

To reflect current, forward-looking data, Mr. Pitkin replaced 1998-vintage data with updated line counts, dial equipment minutes ("DEMs") and call completions for year-end 2002, which is the approximate mid-point of the expected three-year period during which these rates would be in effect. AT&T/WCOM Exh. 1 (Pitkin Dir.) at 11; AT&T/WCOM Ex. 23 (AT&T/WCOM Cost Model) at 5-6 & Att. C. On surrebuttal, Mr. Pitkin adjusted the line counts for special access lines to reduce the line count from 2.8 million to 2.1 million. This change was based on information provided by Verizon in discovery and reflected conservative assumptions about Verizon's line count and costs. AT&T/WCOM Exh. 14 (Pitkin Surreb.) at 71-73; Tr. 5545-46 (Pitkin).

For plant-specific expenses, Mr. Pitkin replaced 1998 nationwide ARMIS expense and investment ratios with Verizon Virginia-specific ARMIS expense and investment ratios for 2000. AT&T/WCOM Exh. 1 (Pitkin Dir.) at 11; AT&T/WCOM Exh. 23 (AT&T/WCOM Cost Model) at 5-6 & Att. C.

(3) Modifications to Common Support Expenses

Mr. Pitkin substituted an eight percent mark-up for the per-line cost based on regression analyses adopted in the Commission's Synthesis Model for USF calculations. The per-line approach did not estimate the appropriate common support allocation for individual UNEs and also assumed inappropriately that embedded cost data per line could be used as a proxy for forward-looking common costs. AT&T and WorldCom developed the eight percent

figure based on an analysis of RBOC common overhead ratios. AT&T/WCOM Exh. 1 (Pitkin Dir.) at 12-13; AT&T/WCOM Exh. 23 (AT&T/WCOM Cost Models) at 5-6 & Att. C.[20]

In addition, Mr. Pitkin adjusted the network operations expenses to reflect Verizon-Virginia's expected 2002 expenses based on Verizon-specific information. Mr. Pitkin later agreed with Verizon that approximately 6% of these expenses failed to flow through correctly to the associated UNEs, and he corrected this error in his Surrebuttal Testimony. Verizon Exh. 108 (Tardiff Reb.) at 62-63; Verizon Exh. 109 (Murphy Reb.) at 73-77; AT&T/WCOM Exh. 14 (Pitkin Surreb.) at 66, 72.

(4) Modifications to Incorporate Input Changes

Mr. Pitkin relied, where appropriate, on the default inputs included in the Synthesis Model. He also made a number of changes to user-adjustable inputs of the Synthesis Model to include Virginia-specific data and to reflect more realistic assumptions about the Verizon Virginia network in developing costs for UNEs AT&T/WCOM Exh. 1 (Pitkin Dir.) at 18-22; AT&T/WCOM Exh. 23 (AT&T/WCOM Cost Models) at 8-10 & Att. G:

- The cluster line fill factor was increased from 80% to 90% to reflect a more appropriate DLC utilization rate;[21]
- The ratio of DS-1 lines-to-business lines was changed from 12.75% to zero, and the percent of special access lines that are DS-1s was changed from 91.75% to zero. The Synthesis Model uses DS-0 equivalents, rather than physical line counts, as an input. Making this change ensures that the DS-0 loop costs determined by the Model include the full cable investment required for a physical two-wire loop. With this change, the Synthesis Model uses the same line counts for calculating investments as is used to calculate the cost per line.

[20] If the Commission were to decide not to adopt the eight percent markup, then Mr. Pitkin recommends an alternative per-line calculation adjusted to permit calculation of UNE-oriented outputs. AT&T/WCOM Exh. 1 (Pitkin Dir.) at 13-17; AT&T/WCOM Exh. 23 (AT&T/WCOM Cost Model) at 6-7 & Att. C.

[21] AT&T/WCOM Exh. 6 (Riolo Dir.) at 37.

- The road distance factor was reduced from 1.0 to 0.9 to help correct for the FCC Synthesis Model's use of surrogate customer location data. Without this adjustment, the model exaggerates dispersion and inflates the amount of cable and structure actually required to connect Verizon-VA customers.

- The structure mix percentages for distribution cable, copper feeder cable and fiber feeder cable were modified to reflect Verizon-VA-specific data;[22]

- Feeder structure costs were reduced by 40% to reflect sharing of feeder and distribution facilities;[23]

- Structure sharing inputs were changed to reflect more appropriate forward-looking values for Verizon-VA;[24]

- DLC inputs relating to line cards, equipment and site preparation costs were modified to reflect more appropriate values for Verizon-VA;[25]

- Fiber cable costs were reduced from $3.50 to $1.80 to be consistent with the 24-strand fiber cable cost assumption in the loop portion of the model;

- The additional cost for buried cable was eliminated because it is already included in the buried cable costs. Therefore, the separate input for buried sheath addition was reduced from $0.20 to zero;

- Conduit material costs was increased from $0.60 to $0.72 per foot to be consistent with the loop portion of the model;

- The cost of capital assumptions in the FCC Synthesis Model was modified to reflect the relevant forward-looking risks and capital costs that Verizon is likely to experience in Virginia;[26]

- The corporate overhead factor was adjusted from zero to eight percent as described above;

- The economic lives and net salvage percentages in the Original Synthesis Model have been modified to reflect more realistic forward-looking inputs for Verizon in Virginia;[27]

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[22] *Id.* at 39-43.

[23] *Id.* at. 12.

[24] AT&T/WCOM Exh. 12) (AT&T/WorldCom Recurring Cost Panel Reb.) at 76-78; AT&T/WCOM Exh. 18P (Riolo Surreb.) at 15-18.

[25] AT&T/WCOM Exh. 6 (Riolo Dir.) at 13-36.

[26] AT&T/WCOM Exh. 5 (Hirshleifer Dir.).

[27] AT&T/WCOM Exh. 3 (Lee Dir.).

- The percent of switching costs that are traffic sensitive was change was changed from 70% to 23% based on the testimony of Ms. Pitts.

(5) Calculation of Four-Wire Loop and DS-1 and DS-3 Loop

Mr. Pitkin also determined the cost of the four-wire loop and DS-1 and DS-3 loops using inputs derived from the Synthesis Model. The four-wire loop cost was based on a 1.7 factor based on engineering judgment and an analysis of the underlying loop costs. AT&T/WCOM Exh. 1 (Pitkin Dir.) at 23-24; AT&T/WCOM Exh. 23 (AT&T/WCOM Cost Models) at 10-11 & Att. J. Costs for DS-1 and DS-3 loops were developed using various assumptions, including a 9.6-1 cost relationship between DS-3 and DS-1 lines as determined by the Commission,[28] in developing a DS-0 equivalent-to-physical line ratio of 4.3 for DS-1s and a DS-0-equivalent-to-physical line ratio of 41.3 for DS-3s. AT&T/WCOM Exh. 1 (Pitkin Dir.) at 25-26; AT&T/WCOM Exh. 23 (AT&T/WCOM Cost Models) at 11.

(6) Changes to Interoffice Module

Based on the recommendation of AT&T/WCOM witness Steve Turner, Mr. Pitkin also made changes to the interoffice module of the Synthesis Model in his surrebuttal testimony to incorporate changes previously made to the module in other state proceedings. These changes involved changes to approximately 20 inputs and algorithms in the interoffice module and addressed criticisms of the HAI model (which serves as the basis for the Synthesis Model's interoffice calculations) raised by Verizon in New York and Massachusetts state cost proceedings. These changes also updated the prices used for interoffice equipment based on a BellSouth ex parte filing with the Commission. AT&T/WCOM Exh. 14 (Pitkin Surreb.) at 66, 72; AT&T/WCOM Exh. 19 (Turner Surreb.) at 12; Tr. 5599-5642 (Turner, Pitkin).

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[28] *In the Matter of Transport Rate Structure and Pricing*, FCC Docket 91-213, Third Memorandum, Opinion and Order, Released December 22, 1994, ¶¶ 62,63.

d. Verizon's Criticisms of the Synthesis Model Are Without Merit

Verizon's arguments against the Synthesis Model largely rehash claims that Verizon previously raised with the Commission during its development of the FCC Synthesis Model. Many of those claims are dealt with in the discussion of the specific issue raised by Verizon. Verizon also raises several general arguments about the Synthesis Model, which are equally groundless.

Verizon's principal claim is that the Synthesis Model cannot determine UNEs because it merely "an expedient approach to identifying the relative differences among states regarding the costs of providing certain narrowly-defined services supported by the federal USF mechanism." Verizon Exh.109 (Murphy Reb.) at 12.

This criticism confuses the FCC's particular *application* of the Synthesis Model in the federal USF program with the *capabilities* inherent in the Synthesis Model platform. With respect to the capabilities of the Synthesis Model, the FCC's *Universal Service Fifth Order* states:

> Consistent with the Joint Board's recommendation, the Commission concluded in the Universal Service Order that it would need to estimate costs based on a careful analysis of efficient network design, engineering practices, available technologies, and current technology costs. That is, to estimate forward-looking costs accurately, the Commission decided to look at all of the costs and cost-causative factors that go into building a network. The Commission decided to do this in two stages: first, it would look at the network design, engineering, and technology issues relevant to constructing a network to provide the supported services. Second, the Commission said that it would look at the costs of the components of the network, such as cabling and switch costs, and various capital cost parameters, such as debt-equity ratios and depreciation rates ("input values"). Platform Order at 11-12, (footnotes deleted).
>
> This Order includes our conclusions as to the platform selection, the first of the two stages. . . . Below we adopt a synthesis of the best aspects of each of the three models before us in this

> proceeding. We recognize that, of necessity, models estimate the forward-looking cost of providing the supported services. Such analysis is, however, the only practicable method that presently exists for determining forward-looking costs on a widescale basis, and we expect that the synthesis model will generate accurate estimates of the forward-looking of providing the supported services.

Universal Service Fifth Order at ¶ 11-12 (footnotes omitted).

The FCC recognized two facts in deciding how to *apply* the Model in calculating the USF subsidy. First, the size of the federal USF fund was initially more likely to be a top-down number that had to be allocated to the various states (and Puerto Rico and the District of Columbia) than a bottom-up calculation of the federal portion of USF on a state-by-state basis. Second, evaluating and approving state-specific (and, perhaps, company-specific) inputs for each state to determine the federal portion of USF in each state would place an enormous burden on FCC staff. For these reasons, the FCC decided to use the Model with national inputs that are uniform for all states.[29]

As the *Universal Service Fifth Order* makes clear, however, the Synthesis Model platform is designed to do much more. The FCC staff who developed the outside plant algorithms of the Synthesis Model, for example, sought to develop a tool that would calculate

[29] Messrs. Tardiff and Murphy's suggestion (Verizon Exh.108 (Tardiff Reb.) at 25-26; Verizon Exh. 109 (Murphy Reb.) at 5) that the Commission adopted the Synthesis Model knowing that it systematically understates costs is totally without merit. The decision to rely on relative costs occurred after the adoption of the *Universal Service Fifth Order*, which determined the methodology for calculating the investments and costs in the Synthesis Model. The FCC stated in the *Universal Service Fifth Order* that the Synthesis Model provided a reasonable estimate of forward-looking costs, and the Commission has never stated in any order that the Synthesis Model systematically understates costs, as Messrs. Tardiff and Murphy claim. AT&T/WCOM Exh. 14 (Pitkin Surreb.) at 11 n. 13.

forward-looking costs for outside plant accurately and in a geographically-specific way.[30] The underlying Model algorithms can use state-specific customer demand, customer location and geological data to efficiently design plant and facilities on a geographically discrete basis. Furthermore, hundreds of inputs in the Synthesis Model can be modified, as appropriate, to reflect state-specific or company-specific characteristics. In short, there is nothing to prevent -- and much to recommend -- the use of the Synthesis Model in this proceeding.

Furthermore, the notion that a USF model cannot inherently be used to develop UNE costs is baseless.[31] The three cost models that serve as the basis for the Synthesis Model were in fact all developed to derive UNE costs. This is hardly surprising. The underlying elements necessary to provide basic local service are the very same elements at issue in both universal service and unbundled network element proceedings. The Commission itself has recognized the connection between the two processes:

> We also encourage a state, to the extent possible and consistent with the above criteria, to use its ongoing proceedings to develop permanent unbundled network element prices as a basis for its

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[30] Bush, Kennet, Prisbrey, Sharkey, and Gupta, *Computer Modeling of the Local Telephone Network* at 4-6 (Oct. 1999) (attached as Exhibit B to AT&T/WCOM Exh. 23 (AT&T/WCOM Cost Model).

[31] Indeed, in addition to using the Synthesis Model in USF proceedings, the Commission has used the Synthesis Model to "benchmark" the appropriateness of the relative prices for unbundled loops and switching in two orders addressing applications for interLATA authority under Section 271 of the Telecommunications Act of 1996. *In the Matter of Joint Application by SBC Communications Inc., Southwestern Bell Telephone Company, and Southwestern Bell Communications Services, Inc., d/b/a Southwestern Bell Long Distance for Provision of In-Region, InterLATA Services in Kansas and Oklahoma*, CC Docket No. 00-217, Memorandum and Opinion Order, rel. January 22, 2001, at ¶ 84; *In the Matter of Application of Verizon New England Inc., Bell Atlantic Communications, Inc. (d/b/a Verizon Long Distance), NYNEX Long Distance Company (d/b/a Verizon Enterprise Solutions) and Verizon Global Networks Inc., for Authorization to Provide In-Region, InterLATA Services in Massachusetts*, CC Docket No. 01-09, Memorandum and Opinion Order, rel. April 16, 2001, at ¶¶ 22-23.

> universal service cost study. This would reduce duplication and diminish arbitrage opportunities that might arise from inconsistencies between the methodologies for setting unbundled network element prices and for determining universal service support levels. In particular, we wish to avoid situations in which, because of different methodologies used for pricing unbundled network elements and determining universal service support, a carrier could receive support for the provision of universal service that differs from the rate it pays to acquire access to the unbundled network elements needed to provide universal service. Consequently, to prevent differences between the pricing of unbundled network elements and the determination of universal service support, we urge states to coordinate the development of cost studies for the pricing of unbundled network elements and the determination of universal service support.

Universal Service First Order at ¶ 251.

The FCC and FCC Staff, as the developers of the Synthesis Model, well understood the capabilities of the Synthesis Model. There is no reason why – and Verizon has not presented any such reason why – the Synthesis Model is not perfectly suited to develop UNE costs. AT&T/WCOM Exh. 14 (Pitkin Surreb.) at 10-12.

Verizon's assertions that the Synthesis Model lacks documentation and is difficult to run and analyze are also baseless. Verizon Exh. 108 (Tardiff Reb.) at 22-26. Verizon concedes that the documentation provided by Mr. Pitkin in this proceeding has been "voluminous," *id.* at 22, but claims it is not enough. Rest assured that the Synthesis Model documentation will *never* be sufficient to satisfy Verizon. This Commission knows well, however, that Verizon and its predecessor entities were full participants in the USF proceedings leading to the adoption of the FCC Synthesis Model, and thus cannot claim to be ignorant of the workings of the Model. Without doubt, Verizon has had the resources and ability to conduct a full and thorough analysis of the Synthesis Model. Indeed, Verizon's repeated filings and testimony about alleged shortcomings in the Synthesis Model – more than 200 pages of testimony alone from Messrs.

Murphy and Tardiff -- belie any suggestion that it cannot run or understand the Model. AT&T/WCOM Exh. 14 (Pitkin Surreb.) at 17-18.[32]

Verizon's benchmarking claims are equally without merit. Verizon Exh. 108 (Tardiff Reb.) at 26-34. Dr. Tardiff argues that the Synthesis Model is not validated by comparison with other models but relies on incompatible and outdated data in making his comparisons. Thus, Dr. Tardiff's claim that the FCC's Synthesis Model produces loop costs three times higher than those of Mr. Pitkin's Synthesis Model is meaningless. Much of the difference is explained by the fact that the original model used 1998 data, while the Synthesis Model used forecasted 2002 figures. AT&T/WCOM Exh. 14 (Pitkin Surreb.) at 21-25. Increase in demand over that period significantly lowered average costs per line. *Id.* at 21.[33] The difference is also explained in part by reliance on Virginia-specific inputs in the Synthesis Model, and in certain corrections to the original model that Verizon does not contest. *See id.* at 22. Dr. Tardiff's loop cost comparison between the Synthesis Model and prior HAI model loop costs is equally infirm, as he relies on data from different eras, from different jurisdictions (some Virginia-specific and some nationwide) and uses models with different methodologies for determining customer locations. With these differences, it is no surprise that the models would produce different results. *Id.* at 23-25.

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[32] Verizon's claim about the Synthesis Model's use of Turbo Pascal is equally without merit. Verizon Exh. 108 (Tardiff Reb.) at 23. If Verizon were actually concerned about using Turbo Pascal and not just making litigation noise, it could have contacted Borland about making arrangements to use Turbo Pascal. Or it could have called Mr. Pitkin, who contacted Borland and arranged to make available the Turbo Pascal program to interested parties in these cost proceedings. Verizon has never contacted Mr. Pitkin about using the program. Tr. 4571-73 (Pitkin); AT&T/WCOM Exh. 14 (Pitkin Surreb.) at 18 n. 18.

[33] Similarly, Verizon's comparison of HAI results to Synthesis Model results ignores the fact that the version of the HAI model relied on 1996 data. AT&T/WCOM Exh. 14P (Pitkin Surreb.) at 23.